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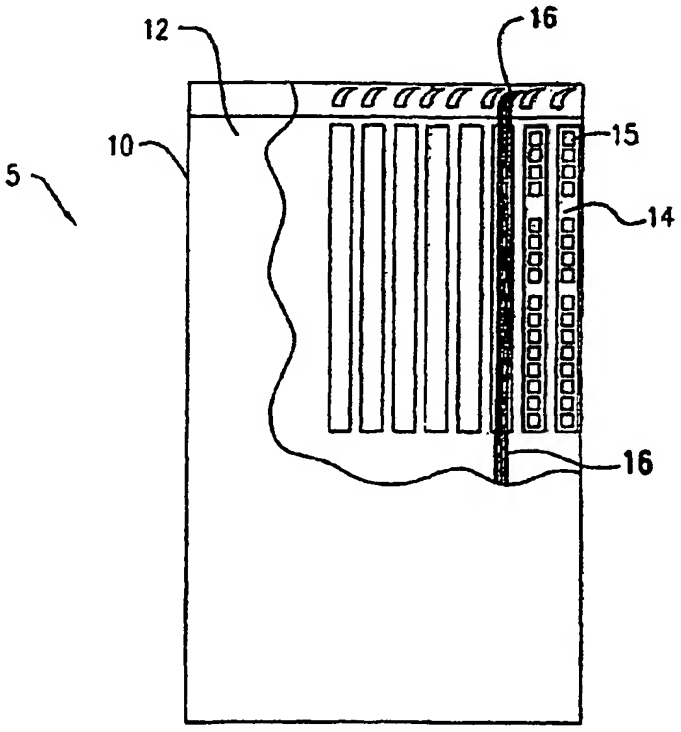
(54) Title: BLANK MODULE WITH CONDUIT RECEPTACLE FOR A COMMUNICATION DEVICE



(57) Abstract: A blank module for a communications system such as an optical networking device is provided. A base is adapted to fit within a space in the communications system reserved for a working module such as an optical line module. At least one conduit receptacle is disposable on the base and capable of retaining a communications conduit at a predetermined length so as to be connectable to a component of the working module that replaces the blank module in the communications system. In this way, any conduits that are not being used at a given time owing to the absence of a working module are sized accordingly and will not have to be lengthened, shortened, or replaced when the actual working module is installed. The conduit receptacle can be used in a working module to substitute for an electrical connector.

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BLANK MODULE WITH CONDUIT RECEPTACLE FOR A COMMUNICATION DEVICE

RELATED APPLICATIONS

This application is a continuation-in-part of U.S. Patent Application No. 09/915,405 entitled Blank Module with Conduit Retainer, filed July 27, 2001, internal docket number 407, and incorporates by reference all of the teachings therein.

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates generally to the communications field and more particularly to a blank module with conduit or cable place-holding and length-determining features.

Description of the Related Art

Presently, it is a problem in the field of communication cable installation to insure the precise placement of the communication cable without the possibility of damage or performance degradation to the communication cable by the provision of tight bends, or inappropriate use of fasteners, or inadequate support to the communication cable. Such communication cables include conventional telephone cable having a plurality of copper conductors, coaxial cable, optical fiber, or the like. In all of these applications, the minimum radius of curvature of the communication cable is well defined, and bending the communication cable in a tighter bend can cause damage to the communication medium housed within the cable. The installer of communication cable is thus faced with the problem of routing the communication cable over surfaces, which typically includes sharp bends,

without over bending the communication cable, yet also securing the communication cable to these surfaces in a manner to ensure protection from damage.

This problem is further heightened when fiber optic cables are used. Glass fibers used in such cables are easily damaged when bent too sharply and require observation of a minimum bend radius to operate within required performance specifications. The minimum bend radius of a fiber optic cable depends upon a variety of factors, including the signal handled by the fiber optic cable, the style of the fiber optic cable, and equipment to which fiber optic cable is connected.

Inappropriately routed and damaged fiber optic cables may lead to a reduction in the signal transmission quality of the cables. Accordingly, fiber optic cables are evaluated to determine their minimum bend radius. As long as a fiber optic cable is bent at a radius that is equal to or greater than the minimum bend radius, there should be no reduction in the transmission quality of the cable. If a fiber optic cable is bent at a radius below the minimum bend radius determined for such cable, there is a potential for a reduction in signal transmission quality through the bend. The greater a fiber optic cable is bent below its minimum bend radius, the greater the potential for breaking the fiber(s) contained in the cable.

Optical communication equipment is typically housed in bays, which include a rectangular frame having dimensions conforming to a particular standard, such as the Network Equipment Building Standard (NEBS). NEBS was originally developed by Bell Telephone Laboratories in the 1970s and expanded by Bellcore. Long a requirement for equipment used in the Central Office in the North American Public Switched Network, the NEBS criteria have become a universal measure of network product excellence.

An optical communications equipment frame typically has a plurality of shelves, each having one or more slots for accommodating circuit boards or cards that have optical and

electrical components associated with a communication network mounted thereon. The components include, but are not necessarily limited to lasers, photodetectors, optical amplifiers, switching elements, add/drop multiplexers etc. In addition, fiber optic cables typically connect to one or more components. A typical optical networking device is shown schematically in Fig. 1 and will be described below.

One type of component used in optical communications equipment is a line module. A line module typically accommodates a circuit board or card, and a plurality of optical modules that have optical and electrical components mounted thereon. The line module has an opening for receiving the optical modules so that they may interconnect with the circuit board or card provided on the line module. A line module may also have components, normally contained on the optical modules, integrated directly into the line module. A typical line module is shown in Fig. 2 and will be described below.

Ideally, each shelf of an optical communications equipment frame will be fully populated with line modules, and each line module will be fully populated with optical modules. However, the slots of each shelf typically are not fully populated, thereby resulting in the use of blank (dummy) line modules (alternatively called line module blanks or blank modules) as well as with the use of blank (dummy) optical modules (alternatively called optical module blanks). Such blank modules are structurally configured the same way as functional or working modules, which contain electrical components, but specifically do not contain the typical electrical components found within the working modules. These blank modules typically are used due to the equipment requirements of the user or the desire of the user is to leave room for future expansion of the communications system.

It also may be desirable to route all of the optical fibers (alternatively called fiber optic cables) to be used in a fully-populated communications equipment frame, even if line module blanks or partially populated line modules with optical module blanks are used, to

thereby prevent over-handling and potentially damaging the fiber optic cables. Routing all of the fiber optic cables from the beginning also insures that the cables will already be available when blank modules are replaced with true modules.

Currently in the installation process one of two events may occur: either the fiber optic cables are not provided for the unused port spaces in optical module blanks and line module blanks, or all the fiber optic cables are provided and the unused fiber optic cables are left to hang within the equipment frame. If the cables are not provided, then they need to be routed as additional components are installed in the equipment frame, increasing the potential damage that may be caused by over-handling already-installed fiber optic cables. If the fiber optic cables are all provided initially and the unused fiber optic cables are left hanging in the equipment frame they may be damaged when line modules are moved in and out of adjacent slots in the equipment frame, or when the door to the equipment is opened or closed. More importantly, the installer needs to be able to verify that the fiber optic cables that are installed are of adequate length to reach the ports when optical modules or working line modules are added. If they are too long, they will droop down when connected to the optical modules and will be subject to damage whenever the door to the device is opened or adjacent modules are serviced. Slack optical fibers can be subject to vibration (owing, in part, to ventilating air being blown through the device) that can have an adverse effect on signal transmission. If the optical fibers are too short, they will be installed too tautly, and the minimum recommended bend radius would be violated. Alternatively, if the cables are significantly too short, they might not reach the correct optical modules at all.

The same holds true when other optical or electrical conduits are used. For example, during installation of electrical conduits, such as telephone cable having a plurality of copper conductors, coaxial cable, or the like, one of the two events discussed above may occur. As

used herein, the term "conduit" refers to any electrical, optical, or other like media used to transmit and receive data or information from one point to another.

Thus, there is a need in the art to provide an inexpensive means for retaining conduits within a communications system to permit an installer to route all of the desired conduits for a communications frame, to verify the conduits are routed to the correct length and to prevent the conduits from being damaged while they are stored within the frame.

SUMMARY OF THE INVENTION

The invention includes a blank module for a communications system such as an optical networking device. A base is adapted to fit within a space in the communications system reserved for a working module such as an optical line module. At least one conduit receptacle is disposable on the base and capable of retaining a communications conduit such as an optical fiber at a predetermined length so as to be connectable to a component of the working module that replaces the blank module in the communications system. Any conduits that are not being used at a given time owing to the absence of a functional working module are sized accordingly and will not have to be lengthened, shortened, or replaced when the actual working module is installed. The conduit receptacle may be used in a working line module to substitute for missing electrical connectors.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is an overall schematic of an embodiment of a communications networking device to which the invention is applicable.

Fig. 2 is a perspective view of an embodiment of a line module component of the communications device of Fig. 1.

Figs. 3A-B are front perspective views of a blank module in accordance with an embodiment of the invention.

Figs. 4A-E are perspective views of a conduit receptacle in accordance with an embodiment of the invention.

Fig. 5A is a top plan view of the conduit receptacle of Fig. 4.

Fig. 5B is a side plan view of the conduit receptacle of Fig. 4.

Fig. 6 is a front plan view of the conduit receptacle of Figs. 4 and 5.

Figs. 7A is a top sectional view taken along line 7A—7A of Fig. 6.

Figs. 7B is a top sectional view taken along line 7B—7B of Fig. 6.

Fig. 8 is a schematic of a slot in the faceplate of the blank module of Fig. 3.

DETAILED DESCRIPTION OF EMBODIMENTS OF THE INVENTION

Description of embodiments of the invention will now be given with reference to the attached Figs. 1-8. These drawings are merely exemplary in nature and in no way limit the scope of the invention, which is defined by the claims appearing hereinbelow.

Fig. 1 depicts a schematic of a typical networking device 5 usable in a communication network. For simplicity purposes, reference to a telecommunication network, data communication network or a communication network each shall be viewed as encompassing the meaning associated with all of three of these terms. Device 5 includes a chassis 10 that has an openable door 12 shown in broken view. Within the chassis is disposed some support structure (not shown) such as shelving, hooks, etc., for supporting a series of circuit boards or line modules 14. Fig. 2 shows in perspective a typical line module 14, in this case an LM-16 or 16-port line module (each port has two fiber connections, one for input and the other for output). It is provided with a number of female LC connectors 15 protruding through the faceplate 14A of the line module. Each LC connector 15 has two

recesses, each one adapted to receive one optical fiber 16 having a corresponding male LC connector at its end. Each LC connector 15 is respectively connected to an optical transceiver 19. Line module ("LM") 14 also includes one or more retaining levers 17 which secure the line module inside chassis 10 of networking device 5.

Turning now to Fig. 3, the dummy or blank module 24 of an LM-16 is shown in detail. Blank module 24 includes a faceplate 24A and a substantially planar main section 24B. It is provided with a number of conduit receptacles 25, which take the place of LC connectors 15, mounted in slots 24C formed in faceplate 24A of the blank module 24. Each conduit receptacle 25 has two recesses, each one adapted to receive one optical fiber 16 having a corresponding male LC connector at its end. Unlike the LC connectors 15 of Fig. 2, conduit receptacles 25 are not connected to any optical or electronic components but rather terminate in a flat wall, as will be described below. Blank module 24 also includes one or more retaining levers 27 which secure the line module inside chassis 10 of networking device 5, as well as backplane attachment means 28 for securely connecting the blank module to the backplane of device 5 in a known manner.

Embodiments of the inventive conduit receptacle 25 are shown in detail in Figs. 4-7. Receptacle 25 is shown having a main body 30 with two recesses 32. Each recess 32 is configured and shaped to receive one optical fiber having an LC connector at its end. At the rear portion of recess 32 is rear wall 33. Unlike a conventional female LC connector, which is required to align the male LC connector of an optical fiber precisely with an optical component, conduit receptacles 25 are not for data transmission. Rather, conduit receptacles 25 serve as placeholders for optical fibers in blank module 24. Blank module 24 is configured and shaped to resemble a working module 14 (i.e., one having the appropriate electronic components), and the slots 24C in faceplate 24A are positioned to correspond with LC connectors 15 of a line module 14. As a result, any optical fibers that are measured out to

connect to a given conduit receptacle 25 will also be the precise length to connect to a corresponding LC connector 15 on a working line module 14 when the blank module 24 is removed and the working line module is installed. In this way, the optical fibers 16 undergo significantly less handling and are thus less susceptible to damage. Also, the optical fibers are assured to be the precise length to connect to their respective LC connectors 15 so that the fibers need not be shortened, lengthened, or replaced when a working module 14 is inserted into a networking device 5.

Conduit receptacle 25 is designed to be snap-fitted into slots 24C of blank module 24. As such, receptacle 25 includes at least one locking tab 36 extending from main body 30 along the side thereof and a stopping plate 34, which surrounds the perimeter or circumference of main body 30. When the receptacle 25 is inserted into slot 24C, locking tab 36 engages the rear portion of the faceplate 24A and prevents receptacle 25 from falling out of the front of the faceplate 24A. Stopping plate 34 prevents receptacle 25 from being inserted too far through slot 24C and/or falling out of the rear of faceplate 24A. As best shown in Fig. 7A, a gap 37 is formed between locking tab 36 and stopping plate 34; it is in gap 37 that the rim of faceplate 24A surrounding slot 24C is captured.

As shown in Figs. 5 and 7A, it is preferred (though not required) to provide two locking tabs 36 on opposite sides of main body 30. In the preferred embodiment, locking tab 36 is attached to main body at a fixed end 36A and has a free opposite end 36B. This cantilever leaf spring design enables locking tab to flex when receptacle 25 is inserted into slot 24C and then snap back into position to engage the rim of the faceplate 24A in gap 37. Alternatively, the locking tab need not be cantilevered but could instead be attached at both ends with a bulging central portion that would flex inwardly closer to the main body 30 when insertion occurs.

It is desirable to insure that the conduit receptacles 25 are always and consistently inserted into slots 24C in the same orientation. As such, conduit receptacle 25 is provided with a projection 38 that is preferably asymmetrically disposed on main body 30. Correspondingly, as shown in Fig. 8, slot 24C of faceplate 24A is provided with a cutout 29, which is shaped to receive and matingly accommodate projection 38. In this way, receptacle 25 can only be inserted into slot 24C in one orientation, the orientation in which projection 38 aligns with cutout 29. Alternatively, the slot may be provided with a projection and the receptacle be provided with a mating recess or cutout. The important aspect is that the conduit receptacle and its slot are keyed to prevent insertion of the receptacle in any orientation except the one preferred orientation.

As shown in Figs. 7A-B, the conduit receptacle 25 is made of plastic. Preferably, the material used is V0 fire-resistant and is more preferably like polycarbonate. An example of a particularly well-suited material out of which to make conduit receptacle 25 is Lexan. The conduit receptacle 25 is also preferably made as one piece. This is advantageous over conventional electrical connectors, which typically require either metal bands for the locking pieces, metal contacts to conduct electricity, or both. Hence, the inventive conduit receptacle 25 is less expensive and easier to manufacture.

The embodiments of the invention are not limited to what is shown in the drawings or described above. For example, the conduits are shown to be optical fibers, but an alternative embodiment of the invention is applicable to any type of data transmission line used in communications, for example copper conductors, coaxial cable, or any other type of electrical or optical conductors. The receptacle is shown to accommodate LC connectors, however embodiments of the invention are not limited to LC connectors but rather contemplate all types of connectors. The embodiment shown has two recesses per receptacle as a duplex optical fiber, however the inventive conduit receptacle may have as few as one

recess or as many recesses as is practical for this application. Also, any number of locking tabs may be provided on each receptacle. Similarly, any number of keyed projections or indentations may be provided to correspond with mating indentations or projections in the slots of the faceplate. Embodiments of the conduit receptacles are shown in conjunction with the inventive blank module, however the inventive conduit receptacles may also be used in working line modules to fill in the gaps where an electronic component is not provided or available. If so used, then the keyed projection might not be employed because conventional line modules presently do not have keyed slots. If future line modules are provided with keyed slots, the inventive conduit receptacle may also be so provided.

What is claimed is:

1. A blank module for a communications system, comprising:

a base adapted to fit within a space in the communications system reserved for a working module; and

at least one conduit receptacle disposable on said base and capable of retaining a communications conduit,

wherein the conduit is retained at a predetermined length so as to be connectable to a component of the working module that replaces the blank module in the communications system.

2. A blank module for a communications system according to Claim 1, said base further comprising at least one slot, and said conduit receptacle being lockingly disposable in said slot.

3. A blank module for a communications system according to Claim 2, said conduit receptacle comprising at least one recess adapted to receive an end of the conduit.

4. A blank module for a communications system according to Claim 3, said recess being adapted to receive an LC connector of an optical fiber.

5. A blank module for a communications system according to Claim 2, said conduit receptacle further comprising:

a main body fittable into said slot on said base; and

at least one flexible locking tab extending from said main body,

wherein when said conduit receptacle is inserted into said slot, said locking tab passes through said slot and engages a rear surface of said base near said slot.

6. A blank module for a communications system according to Claim 5, wherein said locking tab is integral with and extends from said main body as a leaf spring.

7. A blank module for a communications system according to Claim 6, wherein said locking tab extends from said main body in a cantilever manner.

8. A blank module for a communications system according to Claim 5, said conduit receptacle further comprising a stopping plate extending circumferentially around at least a portion of said main body, said stopping plate being larger than said slot,

wherein when said conduit receptacle is inserted into said slot, said stopping plate prevents said conduit receptacle from being inserted beyond a predetermined point.

9. A blank module for a communications system according to Claim 8, wherein when said conduit receptacle is inserted into said slot, a rim of said slot is captured between said locking tab and said stopping plate.

10. A blank module for a communications system according to Claim 2, said slot being positioned on said base to correspond with an electrical connector on the working module.

11. A blank module for a communications system according to Claim 1, said base comprising:

a faceplate upon which said slot is formed; and

a main section dimensioned to emulate the working module.

12. A blank module for a communications system according to Claim 11, wherein the blank module comprises a line module blank to hold the place of a working line module.

13. A blank module for a communications system according to Claim 12, wherein the communications system is an optical networking device and the conduit is fiber optic cable.

14. A blank module for a communications system according to Claim 5, further comprising:

at least one asymmetric cutout formed on one of said slot and said main body of said conduit receptacle; and

at least one asymmetric projection formed on the other of said slot and said conduit receptacle corresponding to said cutout,

wherein because said conduit receptacle can only be inserted into said slot in one orientation.

15. A blank module for a communications system according to Claim 1, wherein said at least one conduit receptacle comprises a plurality of conduit receptacles for retaining a plurality of conduits at respective predetermined lengths that correspond to the respective lengths of conduits that connects with a component of the working module that replaces the blank module in the communications system.

16. A conduit receptacle for substituting for an electrical connector in a communications system, capable of retaining a communications conduit and disposable in a slot of a module of the communications system, comprising:

a main body fittable into a slot on a base of the module;

at least one recess formed in said main body adapted to receive an end of the conduit; and

at least one flexible locking tab extending from said main body,

wherein when said conduit receptacle is inserted into the slot, said locking tab passes through the slot and engages a rear surface of the base near the slot.

17. A conduit receptacle according to Claim 16, said recess being adapted to receive an LC connector of an optical fiber.

18. A conduit receptacle according to Claim 16, wherein said locking tab is integral with and extends from said main body as a leaf spring.

19. A conduit receptacle according to Claim 18, wherein said locking tab extends from said main body in a cantilever manner.

20. A conduit receptacle according to Claim 16, said conduit receptacle further comprising a stopping plate extending circumferentially around at least a portion of said main body, said stopping plate being larger than the slot,

wherein when said conduit receptacle is inserted into the slot, said stopping plate prevents said conduit receptacle from being inserted beyond a predetermined point.

21. A conduit receptacle according to Claim 20, wherein when said conduit receptacle is inserted into the slot, a rim of the slot is captured between said locking tab and said stopping plate.

22. A conduit receptacle according to Claim 16, further comprising:

at least one asymmetric projection formed on said conduit receptacle corresponding to an cutout formed in the slot,

wherein said conduit receptacle can only be inserted into the slot in one orientation.

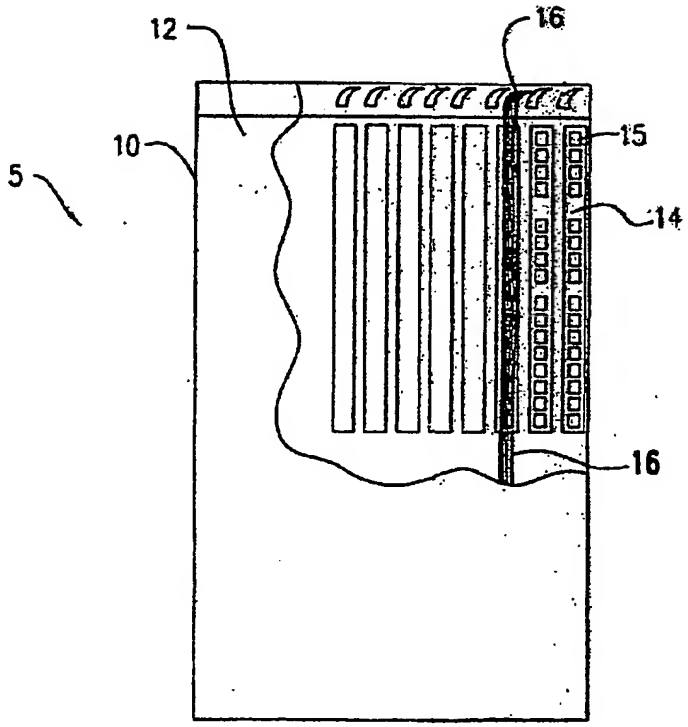

FIG. 1

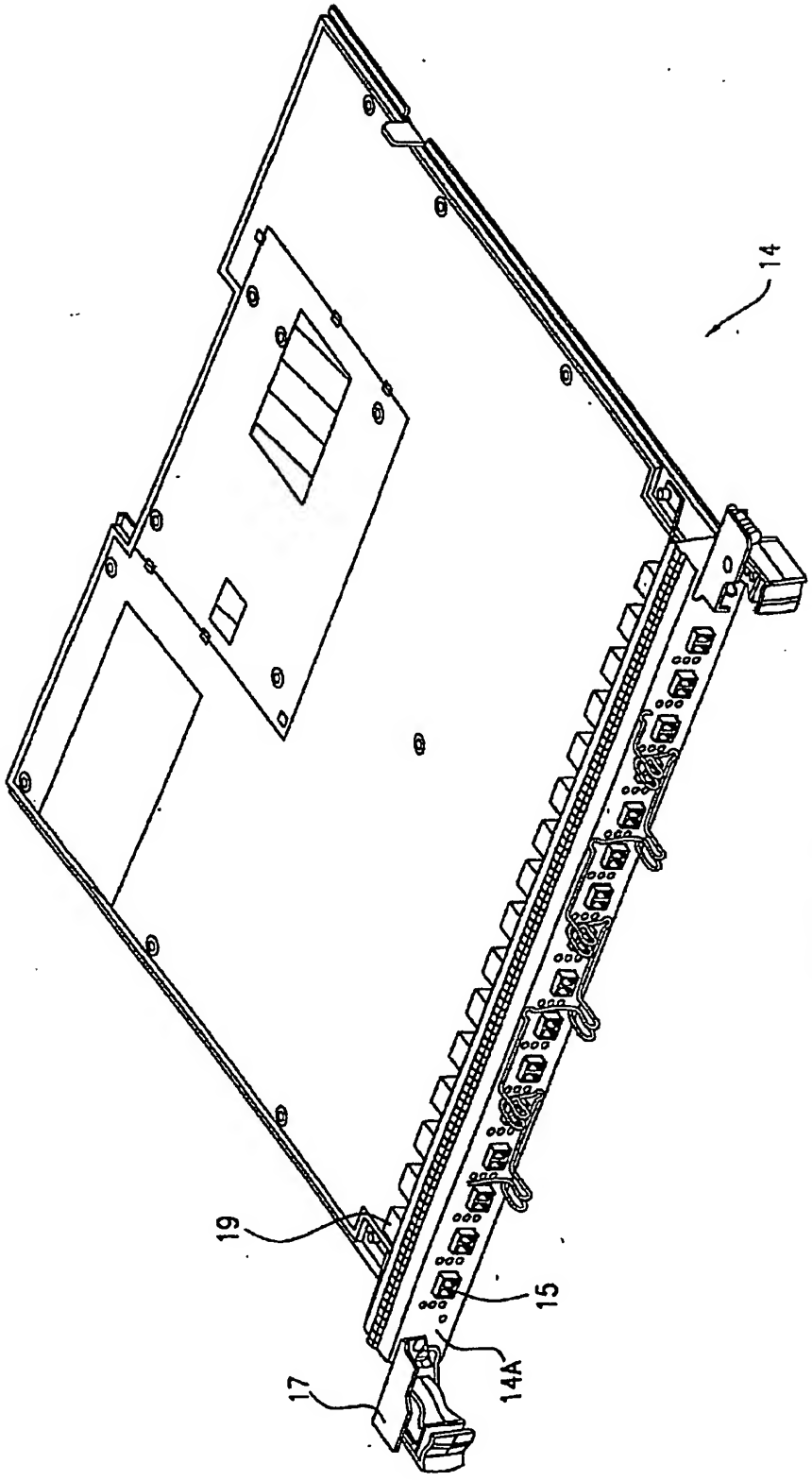

FIG. 2

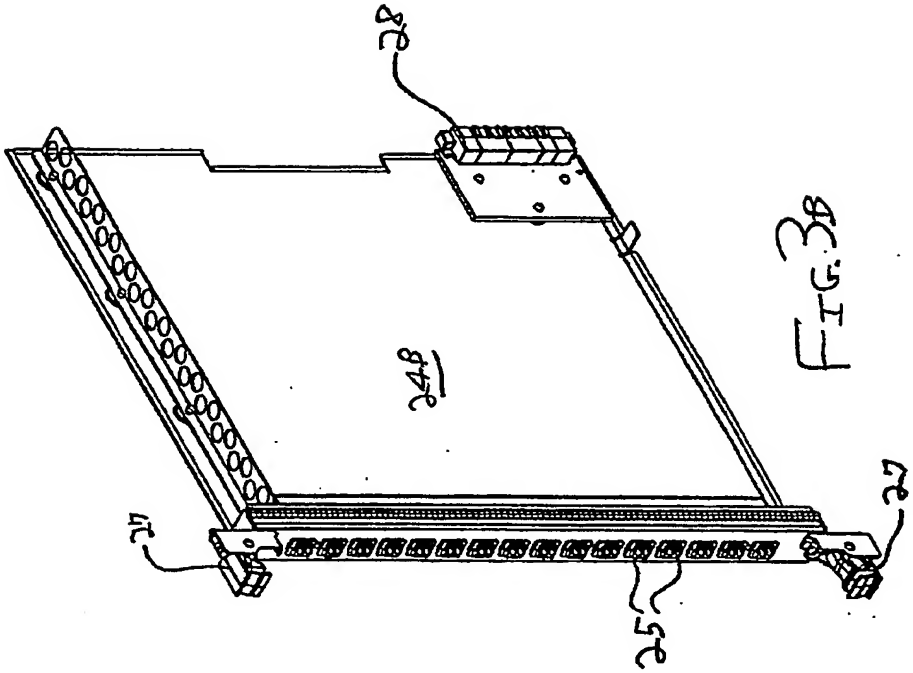

FIG. 3B

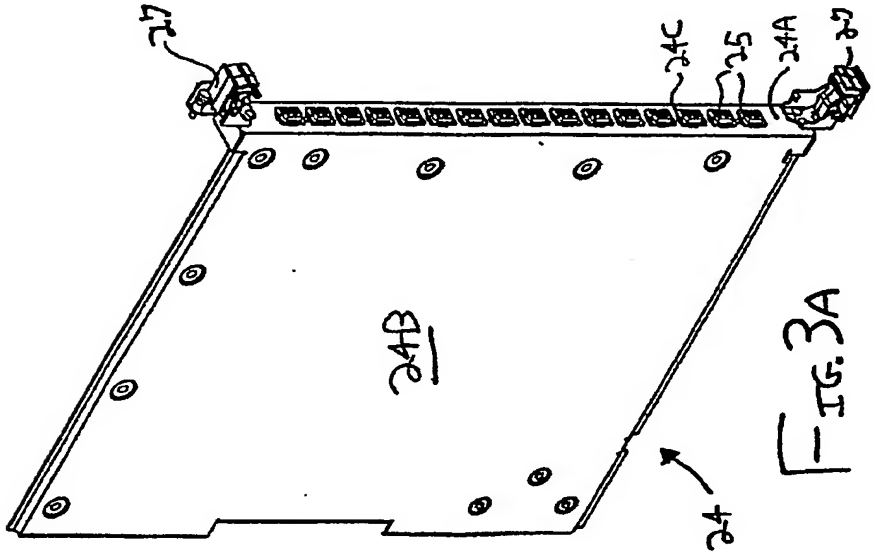

FIG. 3A

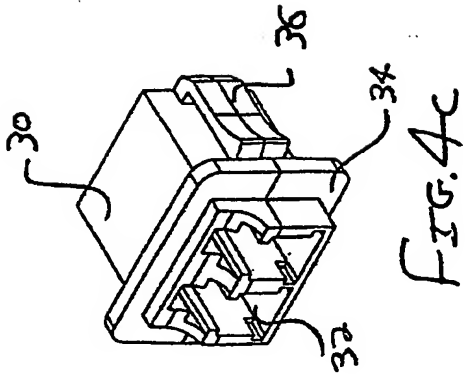

FIG. 4C

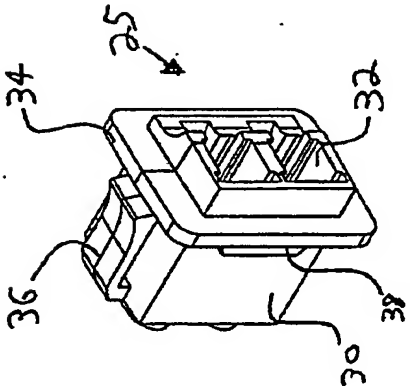

FIG. 4B

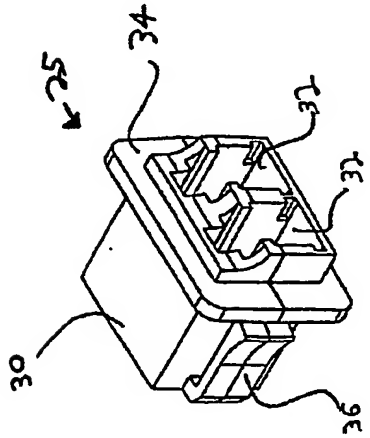

FIG. 4A

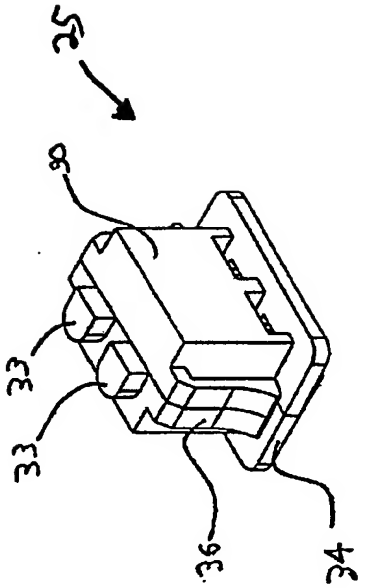

FIG. 4E

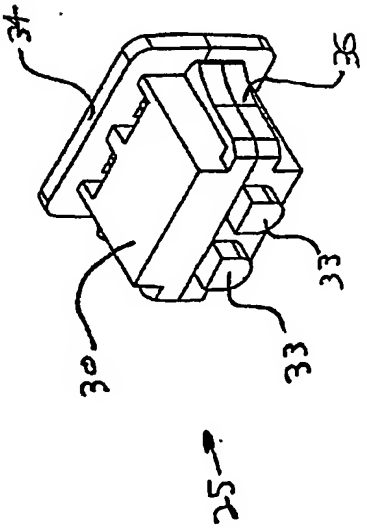

FIG. 4D

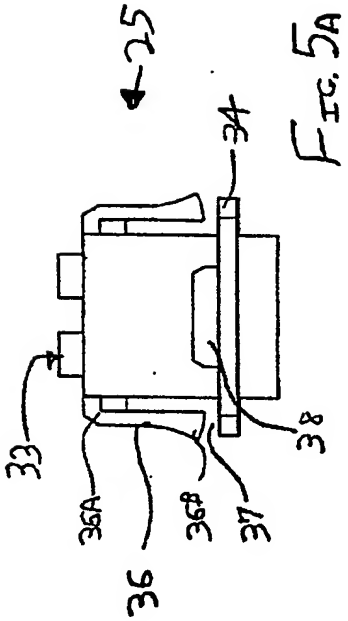

Fig. 5A

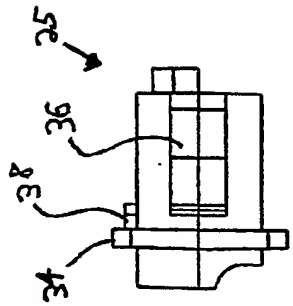

Fig. 5B

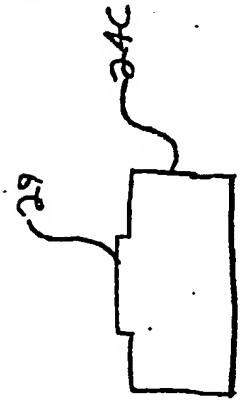

Fig. 8

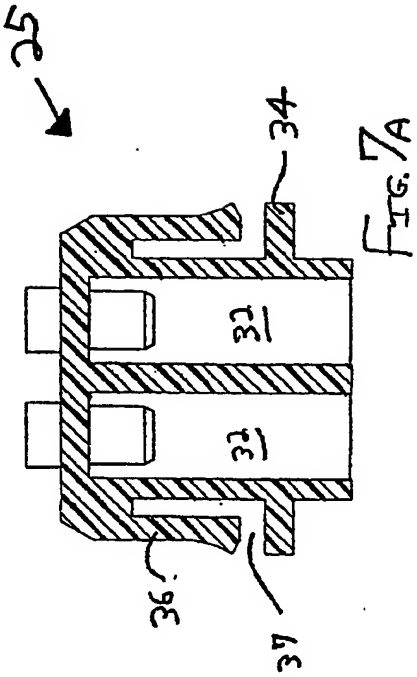

FIG. 7A

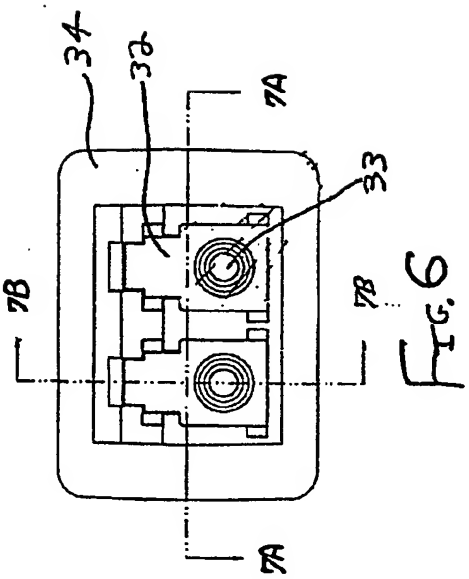

FIG. 6

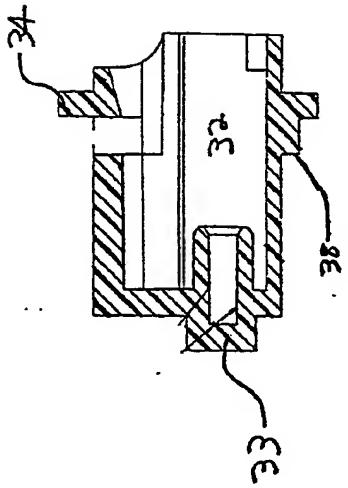

FIG. 7B